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DATE: 12/9/93

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COMMENTS: NOx / Combustion Tuning

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NOx OPTIMIZATION at IGS

*Sent to
Blaine - I
C. J. J.*

Combustion tuning has been a priority issue at IGS and programs to optimize combustion criteria have been implemented since initial startup (5/86) and are on an on-going evaluation.

I doubt if very few utilities have done, and if they have, gone to the extent we have gone to, to satisfy our combustion tuning requirements. Due to the size of our units (ie; overall fuel costs), emphasis on initial acceptance testing and on-going commitment to achieving best possible performance, we have justified spending the time, engineering and making modifications necessary to achieve our goals.

Most other utilities and consultants (including EPRI) are now seeing this avenue as the cheapest route for meeting there NOx compliance requirements. By tuning, balancing, improving boiler performance and reducing overall air flow requirements, a direct NOx reduction can be realized. For IGS, we are already there.

NOx, however, was not specifically singled out as the primary reason for tuning, but a lot of the same overall philosophy applies. The strategy used was to balance fuel flow, air flow, flame stability and air to fuel ratios for uniform combustion. Bad actors on either extremes are identified and addressed. We've found that a poor flame will upset all the combustion criteria, including NOx. *fuel*

It should be noted, the original burner design technology was low NOx two stage burners which from a performance standpoint (with tuning) performed well. When we mention combustion tuning, the parameters we found to be the most effective in evaluating tuning success include: O2, excess air, CO, LOI in fly ash, NOx, temperature profiles and flame stability.

A substantial effort has gone into achieving uniform combustion and ^{maintaining} achieving our target parameters. Projects we have conducted to achieve our goals include the following:

- Fuel Flow Balancing- testing based on clean air flow, dirty air flow and rotoprobe techniques have been used as criteria to determine optimum primary air and fuel balance from burner to burner across a burner row. Coal line restrictors ^{were} ~~are~~ installed to achieve balance criteria.
- Primary Air flow Calibrations- clean air tests are conducted at the pulverizer inlet to determine ^{primary} air flow. Calibration corrections are applied to air flow transmitters to achieve optimum air velocities through the pulverizer and burner lines as well as to provide balance from pulverizer to pulverizer.
- Secondary Air Flow Balancing- secondary cold air flow balancing ~~in~~ both the inner and outer air flow zones have been conducted ~~through~~ through a series of off-line boiler tests. Shrouding on the outer registers and changes to back plate settings were required on the inner registers to achieve side to side, top to bottom and front to rear balancing on the wrap around windbox.
- Burner Turndowns- turndowns on the burners are conducted after every major outage and as needed to verify and adjust burners for flame stability.
- Pulverizer Performance Tests- periodic capacity and fineness testing is conducted on the pulverizers to determine fineness and performance levels and as a means to conduct diagnostics.
- Boiler Performance Testing- monthly performance testing is also ~~conducted~~ conducted on both units to determine boiler efficiency levels and to identify potential problems.

- Burner Register Setup Change- a new burner register setup philosophy change was implemented to help address accelerated burner mechanical degradation due to high burner front temperatures (when burners were in an out-of-service state condition). Flame stabilizers were added, air flow balancing was conducted and register changes were made. This helped to push the flames out from the burner wall and improve flame stability.

- Burner Replacement- the objective for the boiler and burners was to achieve our performance and combustion criteria. What we found, however, was the mechanical and structural aspects of the burner were not quite up to the task. Replacement burners were required on Unit 1 and modifications were made on Unit 2 to satisfy long life and survivability and still be able to achieve combustion and performance requirements.

- Continuing Testing and Optimization- additional testing, such as burner front flame temperature and air flow velocity testing (using hot wire anemometer based technology) are planned as part of our commitment to continue to evaluate and improve combustion criteria

FOR YOUR INFORMATION:

ADDITIONAL NOx REDUCTIONS:

To go beyond where we are now for an additional NOx reduction, we would have to do one of the following:

1) change combustion tuning criteria by reducing excess air flow levels. A relatively small change (~5 to 10%) could be gained by reducing excess air levels from where we are now, however, boiler performance would be compromised due to an increase in CO and LOI levels. This would, of course, suspend our commitment to provide fly ash for off-site sale as a concrete additive.

2) capital modifications for over-fire air capability. NOx reductions in the ~10 to 25% range could be gained from adding overfire air ducts above the burners. This modification (ballpark cost: \$400 to \$500k per unit) would require boiler waterwall openings for overfire air ports, ductwork additions, secondary air dampers, individual port air flow control (louvers) and damper controls.

3) new technology capital improvements such as SLR, etc.
high dollar items